2025

(NEP—2020)

(2nd Semester)

ELECTRONICS (MAJOR/MINOR)

(Basic Semiconductors)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

(SECTION : A—OBJECTIVE)

(*Marks* : 10)

Tick (✓) the correct answer in the brackets provided : 1×10=10

1. Which type of bonding exists in semiconductors?

(a) Ionic bonding ( ) *(b)* Covalent bonding ( )

(c) Metallic bonding ( ) *(d)* Hydrogen bonding ( )

2. The Hall effect is used to determine

(a) the conductivity of a semiconductor ( )

(b) the type of charge carriers ( )

(c) the energy bandgap ( )

(d) All of the above ( )

3. The mobility of electrons is generally _____ the mobility of holes.

(a) lower than ( ) *(b)* equal to ( )

(c) higher than ( ) *(d)* Unpredictable ( )

4. A varactor diode is primarily used for

(a) voltage regulation ( ) *(b)* frequency tuning ( )

(c) rectification ( ) *(d)* signal amplification ( )

5. Which of the following materials is commonly used for manufacturing semiconductors?

(a) Copper ( ) *(b)* Silicon ( )

(c) Aluminum ( ) *(d)* Silver ( )

6. What is the typical barrier potential of a silicon *P-N* junction diode at room temperature?

(a) 0·3 V ( ) *(b)* 0·7 V ( )

(c) 1·2 V ( ) *(d)* 1·5 V ( )

7. The process of adding impurity atoms to a pure semiconductor is called

(a) diffusion ( ) *(b)* ionization ( )

(c) doping ( ) *(d)* oxidation ( )

8. The ripple factor of a full-wave rectifier is approximately

(a) 0·482 ( ) *(b)* 1·21 ( )

(c) 0·812 ( ) *(d)* 1·11 ( )

9. The majority charge carriers in an *N*-type semiconductor are

(a) holes ( ) *(b)* electrons ( )

(c) protons ( ) *(d)* ions ( )

10. The function of a Zener diode in a power supply circuit is

(a) signal amplification ( )

(b) voltage regulation ( )

(c) switching ( )

(d) rectification ( )

(SECTION : B—SHORT ANSWERS)

(*Marks* : 15)

Answer *five* questions, taking at least *one* from each Unit : 3×5=15

UNIT—I

1. Explain how valence electrons contribute to conduction in semiconductors.

2. Describe how a barrier potential is developed in a *P-N* junction diode.

UNIT—II

3. Write the limitations in the operating conditions of *P-N* junction diode.

4. Explain avalanche and Zener breakdown.

UNIT—III

5. A full-wave rectifier operates with an AC supply of 230 V (r.m.s.). Determine the peak output voltage if the transformer has a turn ratio of 10 : 1.

6. What is the function of a clipper circuit? Explain its types.

UNIT—IV

7. Write a short note on a PIN diode.

8. Briefly discuss a Gunn diode.

(SECTION : C—DESCRIPTIVE)

(*Marks* : 50)

Answer *five* questions, taking at least *one* from each Unit : 10×5=50

UNIT—I

1. Discuss the role of valence electrons in atomic bonding. How do valence and conduction bands influence electrical conductivity in different materials? 5+5=10

2. Describe the concepts of mobility, drift and diffusion in semiconductors. How does the continuity equation help in analysing carrier transport in a semiconductor material? 5+5=10

UNIT—II

3. Depict and describe the entire configuration of a power supply system, outlining its key components and explaining their respective functions.

4. Discuss the behaviour of a *P-N* junction diode under different bias conditions. Explain its *V-I* characteristics. 6+4=10

UNIT—III

5. Illustrate the working principles of both a half-wave and a full-wave centre-tap rectifier with appropriate circuit diagrams and corresponding waveforms. Additionally, derive and demonstrate that the efficiency of a full-wave centre-tap rectifier is 81·2%. 4+6=10

6. Draw and explain various types of clipper circuits, including positive clipper, biased clipper and combination clipper. Provide their circuit diagrams and describe their functionality. Also, explain how a Zener diode can be utilized as a symmetrical shunt clipper. 6+2+2=10

UNIT—IV

7. Explain the operations of an IMPATT diode and a PIN diode and their applications. 5+5=10

8. A Zener voltage regulator is required to provide a constant 12 V output. If the input voltage varies from 15 V to 20 V and the load current is 50 mA, calculate the required Zener power rating and the value of the series resistor.

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